

Anti-pest Aeration: A New Twist on an Old Concept

Aeration—blowing ambient air through storage bins using low airflow rates—has been used in commercial and on-farm storage since the 1950s to maintain the quality of grain by keeping it cool. In Kansas and other south-central states, aeration is also used to manage insects in stored wheat. This is achieved by cooling the grain to 60°F or below, a temperature range that slows the activity of most stored-product insect pests.

But few recent studies have been performed to examine whether it's better to direct air from above or below as a means of using temperature to control insects, according to entomologist Frank Arthur and agricultural engineer Mark Casada, both with ARS's Center for Grain and Animal Health Research in Manhattan, Kansas.

To find out, they used bins located at the ARS center to compare “pressure aeration”—which uses fans to push ambient air from the bottom of grain storage bins upwards, and “suction aeration,” which involves reversing the fans to pull air from the top downward. They conducted two 8-month trials using 6 metal storage bins with perforated floors and grain-storage capacities of 1,250 bushels of wheat.

Three bins used pressure aeration, and three used suction aeration. Devices called “anemometers” measured airflow rates, while temperature readings were taken with data loggers attached to special sensor cables pushed to various depths and locations within the stored wheat. Eighteen-inch-long pitfall probe traps monitored the number, location, and species of grain-infesting insects in the top surface of the wheat mass. These included rusty grain beetles, foreign grain beetles, hairy fungus beetles, red flour beetles, sawtoothed grain beetles, rice weevils, and lesser grain borers.

Data analysis showed that, during summer months, suction aeration cooled the stored wheat's upper portion—dubbed the “surface zone”—more quickly than pressure aeration and that this difference correlated to fewer insects in the surface zone. For example, pitfall trap data for rusty grain beetles collected over 5 sampling dates revealed 3,290 in pressure-aeration bins versus 662 in suction-aeration ones. Fewer red flour beetles were observed too: 8,210 trapped in pressure-aeration bins versus 722 in suction-aeration bins. With a few exceptions, these reductions also held true for other species.

Suction aeration's rapid cooling of the grain's surface zone (about 1 foot deep) is advantageous, the researchers note, because that's where insects initially infest the grain after flying in from outside.

The studies reaffirm earlier Manhattan research that aerating bins using three temperature cycles—75°F in the summer, 60°F in early autumn, and 45°F in late autumn—reduced insect populations in experimental bins compared to using two autumn aeration cycles at 60°F and 45°F—the standard practice in south-central states where wheat is harvested in June or July.

Though larger-scale aeration studies are needed, “One benefit could be reduced reliance on the fumigant phosphine for control of insect pest populations,” Arthur and Casada write in a paper currently in press in *Applied Engineering and Agriculture*.—By **Jan Suszkiw**, ARS.

This research is part of Crop Protection and Quarantine, an ARS national program (#304) described at www.nps.ars.usda.gov.

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